FLOOD PLAIN MANAGEMENT STUDY

McCOY CREEK

BERRIEN COUNTY, MICHIGAN

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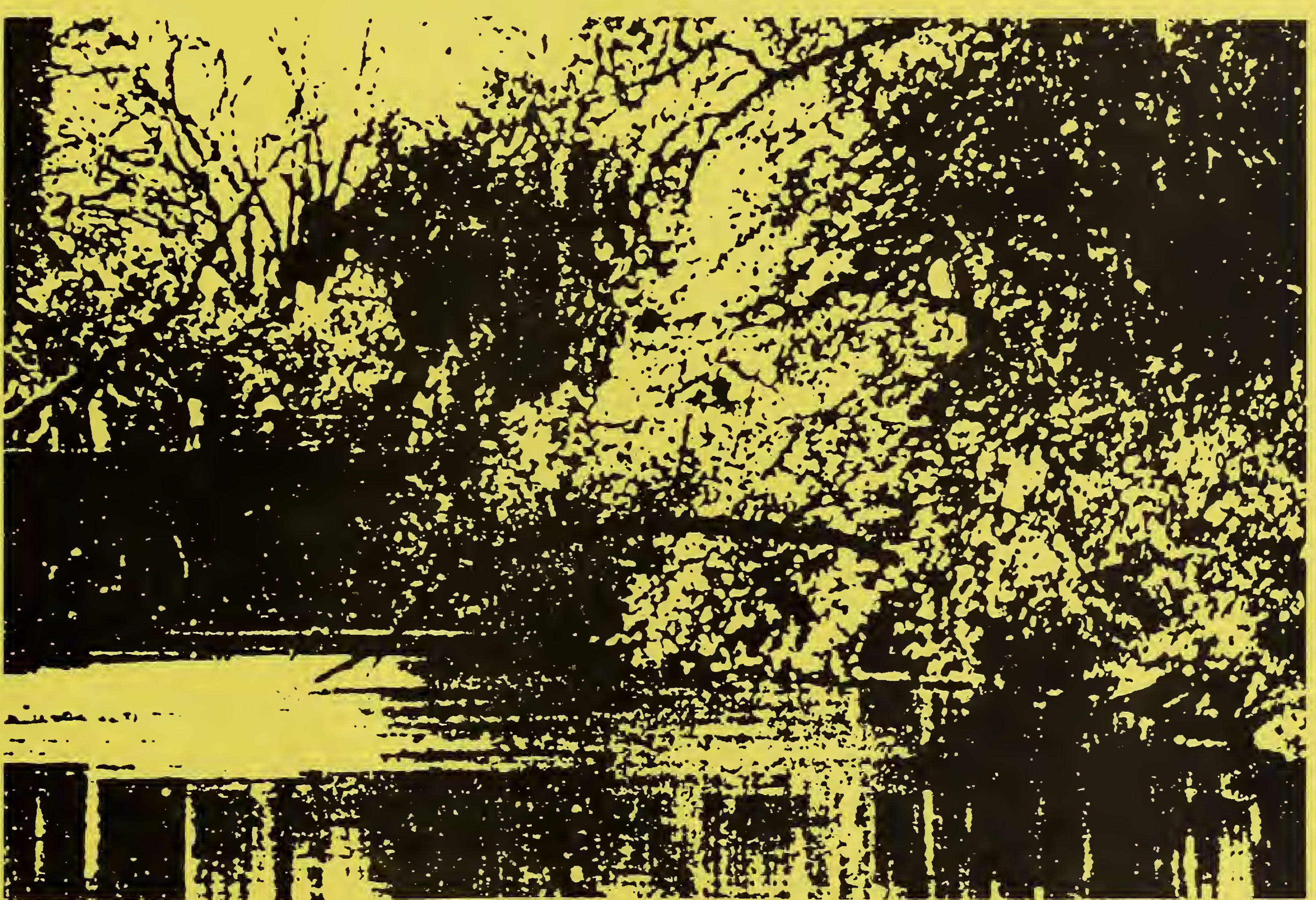

PREPARED BY
U.S. Department of Agriculture
Soil Conservation Service
East Lansing, Michigan

IN COOPERATION WITH
Michigan Department of Natural Resources
City of Buchanan
Galien River Soil Conservation District

UPDATE SHEET - March 1986

McCoy Creek

Flood Plain Management Study

As a result of computations made for this study, the city of Buchanan installed an additional pipe through the Clark Railroad fill. This has significantly reduced head losses through the bridge and reduced upstream flooding for the four evaluated floods. Because of this change, the following actions have been taken:

1. Appendix H - Has been eliminated. Figure 4, Sheet 2 of 5, showing the Flood Hazard Areas and High Water Profiles with the railroad crossing removed or replaced has been combined with Appendix A.

2. Contents, pp. ii and iii - Have been updated to indicate changes.

3. Paragraph 4, p. 8 - The Clark Railroad crossing has been enlarged.

4. Paragraph 2, p. 9 - Appendix H photomap and profiles have been added to Appendix A.

5. Paragraph 4, p. 9 - Table 3 in Appendix C has been removed. Table 3A now shows the current flood elevations.

6. Paragraph 6, p. 9 - With the Clark Railroad crossing enlarged, flooding from the evaluated floods would not flood City Hall. Minor flooding would occur in the parking lot.

7. Paragraph 3, p. 10 - The Clark Railroad crossing has been replaced.

8. Paragraph 2, p. 10 - The head loss for the improved Clark Railroad crossing is now 1.4 feet.

9. Paragraph 3, p. 10 - The Clark Railroad crossing has been replaced.

10. Appendix A, Sheet 2 of 5 - Figure 4 has been added to show current high water profiles and flood hazard areas with the Clark Railroad crossing improved.

11. Appendix C, Table 3 (pp. C-2, C-3 and C-4) - Has been removed because Table 3A (pp. C-5, C-6 and C-7), shows current flood elevations at sections.

12. Appendix D, paragraph 3, p. D-3 - The Clark Railroad crossing has been replaced.

FOREWORD

This report defines the flood characteristics of McCoy Creek in the city of Buchanan, Berrien County, Michigan. Development within the flood plain exists and can be expected to increase in the future.

This cooperative report was prepared for the guidance of local officials in planning the use and regulation of the flood plain. Four potential floods are used to represent the degrees of major flooding that may occur in the future. These floods, the 10-year, 50-year, 100-year and 500-year, are defined in the report and should be given appropriate consideration in future planning for safety of development in the flood plain. Over 4 miles of high water profiles show the expected flood elevations and water depths relative to the stream bed and flood plain. The 100-year and 500-year potential floods are further defined by flood hazard area photomaps that show the approximate areas that would be flooded. About 250 acres of land would be under water from the 100-year flood.

Flood hazard area photomaps and high water profiles are based on existing conditions of the basin, stream and valley when the report was prepared.

Information in this report does not imply any federal authority to zone or regulate the use of the flood plains; this is a state and local responsibility. This report provides a suitable basis for adoption of land use controls to guide flood plain development, thereby preventing intensification of flood losses.

Assistance and cooperation of the U.S. Geological Survey, city of Buchanan and the Michigan Department of Natural Resources in the preparation of this report is greatly appreciated.

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FLOOD PLAIN MANAGEMENT STUDY

McCOY CREEK

BERRIEN COUNTY, MICHIGAN

INTRODUCTION

The flood plains of rivers and streams have been formed by nature to provide for the conveyance of flood flows resulting from large amounts of snowmelt and rainfall. Floods are acts of nature which cannot be wholly prevented by man. Therefore, the long-term solution to reducing flood damage and loss of life is to keep the flood plain free of development which could be damaged or which could obstruct the conveyance of flood waters. There are three basic public actions which can be used to assure that flood plain areas are kept open:

1. Provide public information to make lending institutions and prospective property buyers aware of the flood hazards.

2. Initiate flood plain regulations to prevent the development of the flood plain in a manner which would be hazardous during floods.

3. Acquisition of flood prone areas for use as parks, open space, wildlife habitat and other public uses.

Potential users of the flood plain should base their decisions upon the advantages and disadvantages of such a location. Knowledge of flood hazards is not widespread, and consequently the managers, potential users and occupants cannot always accurately assess the risks. In order for flood plain management to effectively play its role in the planning, development and use of flood plains, it is necessary to:

1. Provide state and local units of government with appropriate technical information and interpretations for use in flood plain management.

2. Provide technical services to managers of flood plain property for community, industrial and agricultural uses.

3. Improve basic technical knowledge about flood hazards in cooperation with other agencies and groups.

Two Michigan state laws provide the Michigan Department of Natural Resources the responsibility and the authority to regulate all development in the flood plain areas.

Act 288, Public Acts of 1967, establishes minimum standards for subdividing land and for new development for residential purposes within flood plain areas. This act requires that preliminary plats be submitted to the Engineering-Water Management Division of the Department of Natural Resources for review and determination of flood plain limits. Upon completion of review and establishment of the 100-year frequency flood plain limits, the preliminary plat may be approved and minimum building requirements specified.

Act 245, Public Acts of 1929 as amended by Act 167, Public Acts of 1968, requires that a permit be obtained from the Engineering-Water Management Division of the Department of Natural Resources before filling or otherwise occupying the flood plain or altering any channel or watercourse in the state. The purpose of this control is to assure that the channels and the portion of the flood plain that are the floodways are not inhabited and are kept free and clear of interference or obstruction which will cause undue restriction of flood carrying capacities.

Requirements established by the Michigan Department of Natural Resources for occupation and development of flood plain areas under Acts 288 and 245 are intended to be minimum requirements only. The Department urges local units of government to adopt reasonable regulations which can be used to guide and control land use and development in flood hazard areas.

The Soil Conservation Service, United States Department of Agriculture carries out flood plain management studies under the authority of Section 6 of Public Law 83-566, in response to Recommendation 9(c), "Regulations of Land Use", of House Document No. 465, 89th Congress, 2nd Session and in compliance with Executive Order 11988, dated May 24, 1977. Flood plain management studies are carried out in accordance with Federal Level Recommendation 3 of "A Unified National Program for Flood Plain Management". The Soil Conservation Service and the Michigan Department of Natural Resources have agreed to carry out flood plain management studies in Michigan under provisions of the 1982 Joint Coordination Agreement. Priorities regarding location and extent of such studies in Michigan have been set in cooperation with the Michigan Department of Natural Resources.

The Galien River Soil Conservation District and the Buchanan City Council believed that a flood plain management study was needed for McCoy Creek due to its urbanization and the flooding problems that have already occurred. The city of Buchanan has determined that there is an increasing need to properly plan for the preservation and use of the flood plain in their urban and rural areas. They have indicated a need to develop technical information along McCoy Creek to develop effective management programs.

The city of Buchanan has adopted a resolution indicating they intend to use the technical information from the flood plain management study as a basis for adopting zoning regulations, health and building codes, subdivision control regulations and such other regulations that may be needed to preserve the environmental quality of their natural resources, and to protect the health, safety, welfare and well-being of the citizens of their community.

A request for a flood plain management study was made by the Buchanan City Council. A plan of work, dated September 1983, was agreed to by the city of Buchanan and the Galien River Soil Conservation District (as sponsors), along with the Michigan Department of Natural Resources and the Soil Conservation Service. Financial contributions for this study were made by the city of Buchanan and Soil Conservation Service. The Galien River Soil Conservation District will assist the city of Buchanan with public information dissemination.

The city of Buchanan provided money for aerial photography for flood plain delineation uses and for watershed modeling purposes. They also furnished assistance to the Soil Conservation Service in gathering basic data.

The city of Buchanan and the Galien River Soil Conservation District will share the responsibilities for public information dissemination. They also provided input to identify and select appropriate flood plain management alternatives.

The Engineering-Water Management Division, Michigan Department of Natural Resources provided coordination services with respect to study area discharges and hydraulics. They reviewed the technical aspects of the study and concurred with study results, as applicable, to implement various state statutes through the Federal Flood Insurance Program.

Natural flood plain values were obtained by Soil Conservation Service field people. Aerial photos and field checks were used to identify and delineate wetland areas. Topographic maps, planning commission data and communications with government officials were used to determine land use and development trends. Soils information was obtained from the published soil survey report for Berrien County.

Historic and archaeological data were obtained from township and county historians. Fishery management information was obtained from Michigan Department of Natural Resources field people.

Two floods are delineated, the 100-year and the 500-year frequency events. These floods have an average occurrence of once in the number of years as indicated; e.g. the 100-year flood occurs once in 100 years on the average. The 100-year flood has a 1 percent chance of being equalled or exceeded in any given year. In addition to the two floods delineated on the aerial photomaps, the 10-year and 50-year floods are also shown on the high water profiles. The flood plain management program enacted by local action is to be based on the technical results and recommendations of this report.

The Engineering-Water Management Division of the Michigan Department of Natural Resources and the Soil Conservation Service, USDA will, upon request, provide technical assistance to federal, state and local agencies and organizations in the interpretation and use of the information developed in this study. For assistance, contact:

Galien River Soil Conservation District
3830 M-139
St. Joseph, Michigan 49085-9605
Telephone: (616) 429-4231

DESCRIPTION OF STUDY AREA

Watershed Area

McCoy Creek is located in southwestern lower Michigan in the southern part of Berrien County. It is located in the U.S. Geological Survey's State Hydrologic Unit 04050001. Its headwaters are located just west and south of the city of Buchanan, within four miles of the city. From there, it flows through Pike Lake, Weaver Lake and Clear Lake and on into Buchanan. Within Buchanan, it winds through industrial and residential areas, sometimes above ground and sometimes below. From there, McCoy Creek flows into the St. Joseph River near the northeast corner of Buchanan.

The drainage area is approximately 20 square miles with land uses of commercial, residential, agriculture, forest and open space. There are numerous culverts and private crossings along McCoy Creek. Some of these are very restrictive and several cause the flooding of buildings. Any replacement of culverts should be evaluated to see what the effect would be on downstream flooding. No other studies have been made by other agencies and organizations that relate to flooding in the study area.

There are four soil associations in the drainage area. Sixty-five percent consists of Ockley-Oshtemo with its nearly level to steep, well drained loamy soils on outwash plains and moraines. Thirty percent is Riddles-Ockley-Oshtemo, which is nearly level to very steep, well drained loamy soils on outwash plains, moraines and till plains. Four percent is Spinks-Oakville-Oshtemo, which is nearly level to very steep, well drained sandy and loamy soils on moraines, till plains, outwash plains and beach ridges. One percent is Morocco-Thetford-Granby, which is nearly level and gently sloping, somewhat poorly drained and poorly drained sandy soils on moraines, till plains, outwash plains, lake plains and beach ridges.

Because of the location of Berrien County in southwestern Michigan, the influence of Lake Michigan is strong throughout most of the year. The main lake effect in Berrien County is cooler spring and early summer temperatures and milder temperatures in fall and winter. The average annual temperature is 49 degrees, with extremes of 101 degrees and -19 degrees Fahrenheit. The average annual precipitation is 35.7 inches and is well-distributed. The average annual snowfall is 58 inches. The growing season averages 187 days annually.

Historically, about 50 percent of the watershed has been used for agriculture. Major areas of cropland are found in the southern portion of the watershed. There are 12 lakes and many swamps in the study area that have a tendency to reduce flood peaks. However, they also encourage development that will cause increased runoff.

Study Area Flood Plain

The study area starts at the St. Joseph River and extends upstream through the city of Buchanan approximately 4 miles. The study area is identified on Figure 1.

There is much present development in the study area flood plain. Approximately 50 percent of the area adjacent to the flood plain is developed. This includes commercial and residential land. There are many buildings that have encroached on the flood plain.

Other land use in the flood plain is mostly idle land that is in woodland or grown up with vegetation compatible with the wet soil conditions. There are only minor acres of cropland.

Sandy loam and muck soils occupy nearly 100 percent of the flood plain area. They are nearly level, poorly or very poorly drained and subject to frequent flooding. Major limitations are wetness and the tendency to become flooded.

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

FIGURE 1

STUDY AREA MAP
McCoy Creek
FLOOD PLAIN MANAGEMENT STUDY
BERRIEN COUNTY
MICHIGAN

SCALE 0 4000 8000 FEET
0 1000 2000 METERS
APPROXIMATE

SOURCE:
MAP FURNISHED BY SCS
FIELD PERSONNEL

SEPTEMBER 1985 4-R-39417-1

USDA SCS NATIONAL CARTOGRAPHIC CENTER, FT WORTH TX 1986

Natural and Beneficial Flood Plain Values

There are several plant communities in the drainage areas. The most significant area is located north of the Amtrak tracks and Bakertown Road.

> Part of the area has unusual botanical and biological interest. This is a low, wet sector of approximately 10 acres lying adjacent to and north of the railroad and directly east of McCoy Creek. Most of the area consists of wet prairie, one of Michigan's rarest types of habitat. The area is exceedingly rich in plant life, containing more than 150 species. Many of these are prairie species that are rare in the state, some of which are on the Michigan list of endangered and threatened plants with urgent need for preservation. Because of the unusual character of this prairie parcel, it is strongly urged that the Buchanan City Commission take the necessary steps to preserve this valuable and unique area. 1/

Also within the area you can find Bakertown Fen.

> This outstanding example of an alkaline fen, a biotic community rare and little known in Michigan, consists of several acres along the Amtrak right-of-way. (Another 4 acres exist at the corner of Bakertown and Chamberlain Roads.) A fen is a type of wetland with water highly charged with calcium; the substrate thus has a high pH and a number of plants adapted to these wet, highly alkaline conditions grow only there. Most fen plants are more tolerant of other conditions but are not less interesting, as they include a number of wet prairie species (prairie is all but gone in Michigan) and the insect-eating pitcher-plant. At least five of the plants of Bakertown Fen are considered "threatened" in Michigan, according to the Michigan Department of Natural Resources list of rare and endangered Michigan plants: spotted phlox, rosinweed, rattlesnake-master, swamp valerian and tuberous Indian-plantain. A number of others are rare or local. The flower color is unusually rich, especially in late summer when the blazingstars, Ohio goldenrod, coreopais, etc. bloom, and in early fall with the flowering of the gentian. Bakertown Fen is well-known to a number of Chicago-area botanists, who especially value it because fens are so much rarer in Illinois. 2/

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1/ Paul W. Thompson, Research Associate in Ecology, Cranbrook Institute of Science.

2/ Leon Schaddelee, Advanced Natural Science Instructor, Benton Harbor Area School District.

Historic and Archeological Resources

Buchanan was settled in 1833 by two mill builders. Charles Cowles of Vermont and Russell McCoy of Virginia, who built their mills near the mouth of McCoy Creek between the present site of the Pears Mill and the mouth of McCoy Creek.

McCoy Creek was not named after Russell McCoy, even though he was one of the earliest settlers on the creek. Rather, it was named after Isaac McCoy, the Baptist missionary, who, in 1822, founded the Carey Mission located between Buchanan and Niles just north of the present Niles-Buchanan Road. McCoy Creek was Isaac McCoy's private fishing place, and from this fact became known as "Old McCoy Creek".

In E. B. Cowles' "Partial History and Directory" of Berrien County, he lists five water power mills on McCoy Creek at and below the village of Buchanan. According to one local authority, there were as many as nine mills at one time along the creek in the city of Buchanan.

The Pears Mill is the sole survivor of the thirteen mills which have existed on the banks of McCoy Creek, beginning in 1833. It was built in the year in which the town's namesake, James Buchanan, became the 15th President of the United States. The Pears Mill has stood on its present site for 126 of the 217 years this country has existed. The Mill Race which serves the Pears Mill was excavated in 1857.

The mill is now in the process of being restored to its original appearance as it was built in 1857. 1/

Also, there are plans to replace the headgate where the Mill Race separates from McCoy Creek, and to redredge the Mill Race.

Wildlife Habitat

Habitat for openland wildlife consists of cropland, pasture, meadows and areas that are overgrown with grasses, herbs, shrubs and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail rabbit and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, tree squirrels, gray fox, raccoon and white-tailed deer.

Habitat for wetland wildife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, shore birds, muskrat and mink.

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1/ Donald F. Ryman, President, Buchanan Preservation Society, Buchanan, Michigan.

Fisheries and Fish Habitat

McCoy Creek is managed as a top quality cold water tributary stream. It is stocked annually, at five different locations, with approximately 4,300 yearling brook trout. McCoy Creek in the immediate vicinity of Buchanan is mostly underground. The area above town is excellent trout habitat, as is the area immediately above its confluence with the St. Joseph River. Those are the areas where it is being stocked at present. The upper portion of the stream in the areas of Curan Road and Buffalo Road is predominantly sand and silt and small amounts of gravel and contains fresh water shrimp, snails, caddis larvae, damsel fly larvae and stone fly larvae. Water temperatures are excellent even in mid-summer, ranging from the mid 50s to low 60s. Stream width in this area averages from 4 to 12 feet, with the upper portion of the stream being quite brushy and very difficult to fish.

The channel from U.S. 12 downstream to the Buchanan Public Works Building, approximately 12 to 20 feet in width, contains much more gravel, the grade is steeper and it has less sand and silt. Food types are the same but also include mayfly larvae and crayfish. Natural food production is excellent and the trout do very well throughout this area. Natural reproduction is very limited in this stream, therefore there is an annual stocking program. The most recent fish collections in the creek were in 1975 and, at that time, brown trout from 3 to 18 inches in length were collected. There are limited numbers of other species present in the stream, the most dominant being the mottled sculpin, which is an indicator species for good quality cold water. The lower section of McCoy Creek, in the vicinity of the St. Joseph River, is also excellent trout habitat. It is characterized as a riffled pool area with fairly fast flowing stream conditions; bottom type is predominantly gravel; has good insect hatches, excellent fishing area and it does grow some fairly large trout.

It is reasonably certain that once salmon and steelhead are passed over the Buchanan Dam, some of those fish will run up McCoy Creek, at least up to town. If they do, there will be some natural reproduction of the species occurring there, but on a limited scale. 1/

Future Land Use Projections

Plans are under way to extend Third Street to Schirmer Parkway. Also, the removal of the Clark Railroad crossing is planned.

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1/ David C. Johnson, District Fisheries Biologist, Department of Natural Resources, Plainwell, Michigan.

Flood Problems

Annual flooding occurs in the early spring due to snowmelt and throughout the year due to heavy rains. Flood damages occur regularly due to encroachment in the flood plain by development. Annual damages are usually confined to homes and businesses adjacent to the creek. The last serious flood occurred in June 1981, when approximately 5 inches of rain fell.

This study reports high water profiles and areas subject to flooding based on analyses of existing stream hydraulics and current watershed and flood plain land use and cover. Water surface profiles are plotted for the 10-, 50-, 100- and 500-year flood events. The expected extent of flooding from two floods, the 100-year and 500-year, is shown on the aerial photomaps. The photomaps indicate the approximate areas subject to flooding by the two floods, under present conditions. An additional photomap in Appendix H shows the areas subject to flooding with the Clark Railroad fill removed.

To determine expected flood levels at a specific location, use Sheet Index, Figure 2 (Appendix A) and refer to the appropriate Flood Hazard Photomaps (Appendix A) to determine the location of the nearest surveyed section and the general area affected. Then, refer to the adjacent plotted high water profiles (Appendix A) to determine the mean sea level flood elevations for that location. Profile elevations may also be used to determine the extent or depth of flooding in any given area by use of detailed field surveys.

Typical valley sections shown on two sheets of Appendix B indicate the effects of the four floods. Flood discharges used for computing high water profiles in the study area are shown in Table 2 in Appendix C. Table 3 in Appendix C shows flood elevations at each of the surveyed valley sections for present conditions. Table 3A shows these flood elevations with the Clark Railroad fill removed.

Flood water depths in the flood plain generally vary from 0 to 9 feet. Velocities range from 0 to 3.8 feet per second.

Primary hazard areas which could experience flooding from large runoff events are in the city of Buchanan from the Public Works Building to City Hall. There are 58 homes and businesses within the delineated flood plain. In some cases, even the more frequent floods (2-year and 5-year) will inundate homes and businesses.

Future development effects were studied where present condition flows were compared to flows for future development and the peak flows increased between 1 and 2 percent. This increase would have a negligible effect on flood elevations of McCoy Creek. Additional consideration should be given to flooding along local tributaries due to any development.

While no computations were made to reflect the problems of ice and debris blockage at bridges, because of the wide possible variations in conditions, a few generalized comments can be made. Ice and debris can often totally block an opening. To determine possible effects, look at the high water profile sheets. At each bridge or culvert, a "low point or road overflow" symbol is shown. Based on field surveys, this is the elevation at which the road would flood. If there is no culvert capacity available, all flows would need to go over the road through this low section. The depth of flow and flooding would depend on the quantity of flow, as well as cross-sectional area available for flow.

Technical documentation for this study is on file with the Soil Conservation Service, USDA, 1405 South Harrison Road, East Lansing, Michigan 48823 (telephone 517-337-6612) and the Engineering-Water Management Division, Michigan Department of Natural Resources, Mason Building, P.O. Box 30028, Lansing, Michigan 48909.

ALTERNATIVES FOR FLOOD PLAIN MANAGEMENT

The objective of flood plain management is to encourage land use and development in such a manner as to minimize potential flood damage. Basic goals are to guide flood plain development consistent with the requirements of nature and the needs of the local area. Flood plain management can:

1. Prohibit uses which are dangerous to public health or safety in times of flood.

2. Restrict building or other development which may cause increased flood heights or velocities.

3. Require that public or private facilities that are vulnerable to floods be protected against flood damage at the time of construction.

4. Protect individuals from investments in flood hazard areas which are unsuited for their intended purposes.

There are numerous flood plain management alternative categories and tools that can be employed to accomplish the above objectives and goals. The ones that apply to this area are suggested below. Other flood plain management techniques should be considered and may well prove to be effective in reducing or preventing flood damages. The Clark Railroad and Third Street crossings should be replaced and others resized when replacement is necessary.

1. Present Condition - This is the "no change" alternative which reflects ongoing flood plain development pressures and management trends. Local governmental units can continue to plan, zone and accept or reject requests for alternative flood plain and adjacent land uses. Flood problems may continue to increase if development continues.

2. Land Treatment - This alternative discusses opportunities to minimize or decrease changes in upland runoff and erosion because of land use changes. The traditional approach of accelerating conservation land treatment, by working with landowners to install conservation practices, will minimize soil erosion and reduce flooding. Installation of such measures as tree planting, windbreaks, forest management, permanent vegetative cover and on-site water storage will all reduce runoff, erosion and sedimentation.

As rural areas urbanize, the increase in peak discharges due to more efficient conveyance paths and increased impervious areas can have a significant adverse impact on downstream areas. There is a growing interest on the part of planners, developers and the public in protecting downstream areas from induced flood damages that may accompany increased peaks and stages. Planning authorities are proposing local ordinances that restrict the type of development permitted and the impact development can have on the watershed. One of the primary controls that could be imposed is that future-condition discharges cannot exceed present-condition discharges at some predetermined frequency of occurrence at specified points on the channel.

Methods to control runoff in urbanizing areas reduce either the volume or the rate of runoff. The effectiveness of any control method depends on the available storage, the outflow rate and the inflow rate. Because a great variety of methods can be used to control peak flows, each method proposed should be evaluated for its effectiveness in the given area.

MEASURES FOR REDUCING AND DELAYING URBAN STORM RUNOFF

Area	Reducing Runoff	Delaying Runoff
Parking Lots	1. Porous pavement a. Gravel parking lots b. Porous or punctured asphalt 2. Concrete vaults and cisterns beneath parking lots in high value areas 3. Vegetated ponding areas around parking lots 4. Gravel trenches	1. Grassy strips on parking lots 2. Grassed waterways draining parking lot 3. Ponding and detention measure for impervious areas a. Rippled pavement b. Depressions c. Basins
Residential	1. Cisterns for individual homes or groups of homes 2. Gravel driveways (porous) 3. Contoured landscape 4. Groundwater recharge a. Perforated pipe b. Gravel (sand) c. Trench d. Porous pipe e. Dry wells 5. Vegetated depressions	1. Reservoir or detention basin 2. Planting a high delaying grass (high roughness) 3. Gravel driveways 4. Grassy gutters or channels 5. Increased length of travel of runoff by means of gutters, diversions, etc.

3. Preservation and Restoration of Natural Values - Flood plains, in their natural or relatively undisturbed state, provide three broad sets of natural and beneficial resources and resource values.

Water resources values include natural moderation of floods, water quality maintenance and groundwater recharge. The physical characteristics of the flood plain shape flood flows. Flood plains generally provide a broad area to spread out and temporarily store flood waters. This reduces flood peaks and velocities and the potential for erosion.

Flood plains serve important functions in protecting the physical, biological and chemical integrity of water. A vegetated flood plain slows the surface runoff, causing it to drop most of its sediment load on the flood plain. Pathogens and toxic substances entering the main water body through surface runoff and accompanying sediments are decreased.

The natural flood plain has surface conditions favoring local ponding and flood detention, plus subsurface conditions favoring infiltration and storage. The slowing of runoff provides additional time for it to infiltrate and recharge available ground water aquifiers and also provides for natural purification of the waters.

Flood plains support large and diverse populations of plants and animals. In addition, they provide habitat and critical sources of energy and nutrients for organisms in adjacent and downstream terrestrial and aquatic ecosystems. The wide variety of plants and animals supported directly and indirectly by flood plains constitutes an extremely valuable, renewable resource important to economic welfare, enjoyment and physical well-being.

The flood plain is biologically important because it is the place where land and water meet and the elements of both terrestrial and aquatic ecosystems mix. Shading of the stream by flood plain vegetation moderates water temperatures; roots and fallen trees provide instream habitat; and near stream vegetation filters runoff, removing harmful sediments and buffering pollutants, to further enhance instream environments.

Flood plains contain cultural resources important to the nation and to individual localities. Native American settlements and early cities were located along the coasts and rivers in order to have access to water supply, waste disposal and water transportation. Consequently, flood plains include most of the nation's earliest archeological and historical sites. In addition to their historical richness, flood plains may contain invaluable resources for scientific research. For example, where flood plains contain unique ecological habitats, they make excellent areas for scientific study. Flood plains may provide open space community resources. In urban communities, they may provide green belt areas to break urban development monotony, absorb noise, clean the air and lower temperatures. Flood plain parks can also serve as nature study centers and laboratories for outdoor learning experiences.

It is recommended that several selected open space areas be preserved, especially in the undeveloped areas. Their preservation, in accordance with soil limitations and good land use management, will reduce development hazards, prevent additional future flood damges and enhance the urban environment.

a. Soils with high water tables should be retained in natural vegetation. No commercial or residential construction should take place on these soils since the limitations are very severe. The Soil Conservation Service has completed a detailed soil survey of Berrien County. Copies of the material, including maps and interpretations, are available for reference in the Galien River Soil Conservation District Office located at 3830 M-139, St. Joseph, Michigan 49085-9605. This information can be used to determine the kind of soils in a given area and their limitations for various uses.

b. Upland open space should be retained in the natural state as much as possible.

c. Private wooded areas on steep slopes should be preserved from all development. Destruction of natural cover on these steep slopes usually causes excessive erosion during construction. Preservation of these wooded sites would also enhance housing developments in the area.

d. Developing areas should provide on-site flood water storage to temporarily store additional runoff volumes and peaks created by their urbanization.

e. Undeveloped flood plain areas should be managed for wildlife and recreation. These areas have potential for an excellent outdoor classroom. McCoy Creek is easily accessible to many school and college students.

4. <u>Non-Structural Measures</u> -

a. Develop and implement, or update, a flood plain protection and zoning ordinance based on the 100-year frequency high water profile and the flood plain delineations (Appendix A). Retaining the storage in the existing flood plain area will be necessary if this flood profile is to remain valid. Reducing the storage capacity in the system will tend to increase elevations and discharges above that indicated in this report.

b. Floodproof buildings and residences already in the flood plain to reduce flood damages. Some basement windows and doors, floor drains and foundations can be modified to reduce effects of flood waters. Materials and supplies stored in vulnerable positions can be relocated and protected. These modifications can be planned and installed where it is desirable and/or feasible to continue using facilities currently in the flood plain.

c. Plans should be developed for alternate routes for auto, truck and emergency vehicle traffic around those roads that will be inundated during the flood. This will require cooperation between city, township, county and state officials.

d. Owners and occupiers of all types of buildings and mobile homes should obtain flood insurance coverage for the structure and contents, especially if located within or adjacent to the delineated flood hazard areas. The city of Buchanan should make necessary applications and pass needed resolutions and zoning ordinances to qualify for subsidized federal flood insurance. Contact the Engineering-Water Management Division, Michigan Department of Natural Resources, Mason Building, P.O. Box 30028, Lansing, Michigan 48909 for additional information.

5. Structural Measures - Flood stages can be reduced by improving road crossings within the city. Some specific crossings that cause higher stages and their corresponding head loss are as follows:

Clark Railroad Crossing	7.8 feet
Third Street	4.3 feet
Crossing "A" (Forged Products)	1.9 feet
Red Bud Trail	1.5 feet
Alexander Street	1.1 feet
Crossing "B" (Forged Products)	1.0 feet

The Clark Railroad and Third Street crossing should be replaced and the others resized when replacement is necessary.

Seven possible structure sites were evaluated for the watershed areas upstream from the city. The structure locations evaluated are shown on the study area map on page 5. The evaluation is based on general site data only. The design of each structure would require more thorough calculations and surveys. The estimated annual damages with each alternative in place are shown in Table 1.

Damage evaluations and alternative analyses were made using four Soil Conservation Service computer programs, fields surveys and topographic map information. The DAMS2 program was used to size and proportion flood water retarding structures. The TR20 program was used to flood route and determine effects of individual structures and selected combinations. The WSP-2 program was used to determine changes in flood profiles because of the flood water retarding effects from the structures. The URB1 program was used to determine damage reductions from the alternatives.

TABLE 1 - ESTIMATED ANNUAL DAMAGES

McCOY CREEK

Alternative	Structure Nos. in Place 1/	Annual Damages	Reduction in Annual Damages
1	None	$16,138	-
2	1	15,575	$563
3	2	15,621	517
4	3	15,132	1,006
5	4	15,635	503
6	5	15,601	537
7	6	15,573	565
8	7	8,687	7,451
9	6 & 7	8,122	8,016
10	3, 6 & 7	7,726	8,412
11	2, 4, 6 & 7	7,282	8,856
12	2, 4, 5, 6 & 7	6,745	9,393
13	1, 3, 5, 6 & 7	6,085	10,053
14	1, 2, 3, 5, 6 & 7	5,739	10,399

1/ Structure locations are shown on study area map on page 5.

1868C

APPENDIX A

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

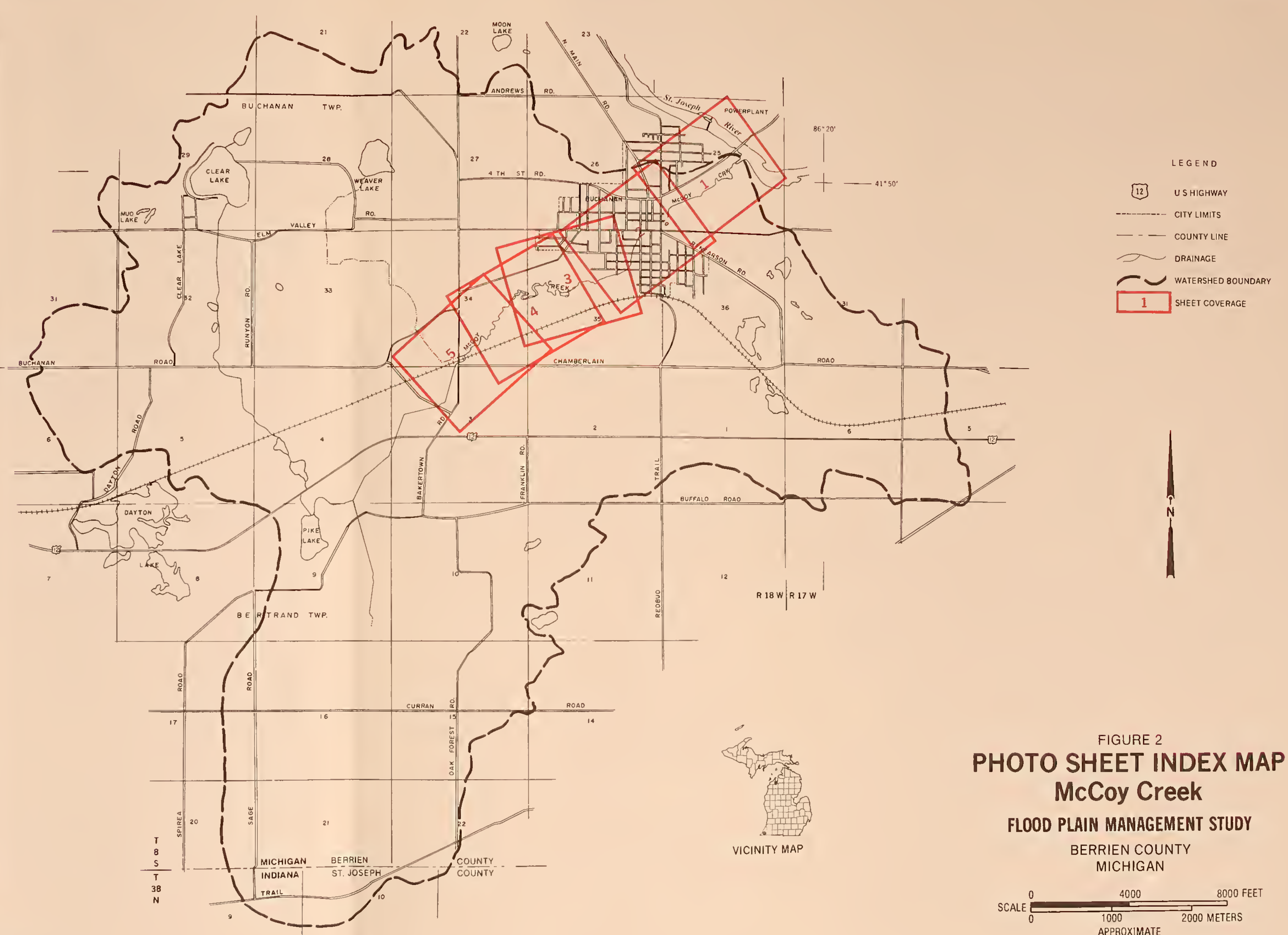
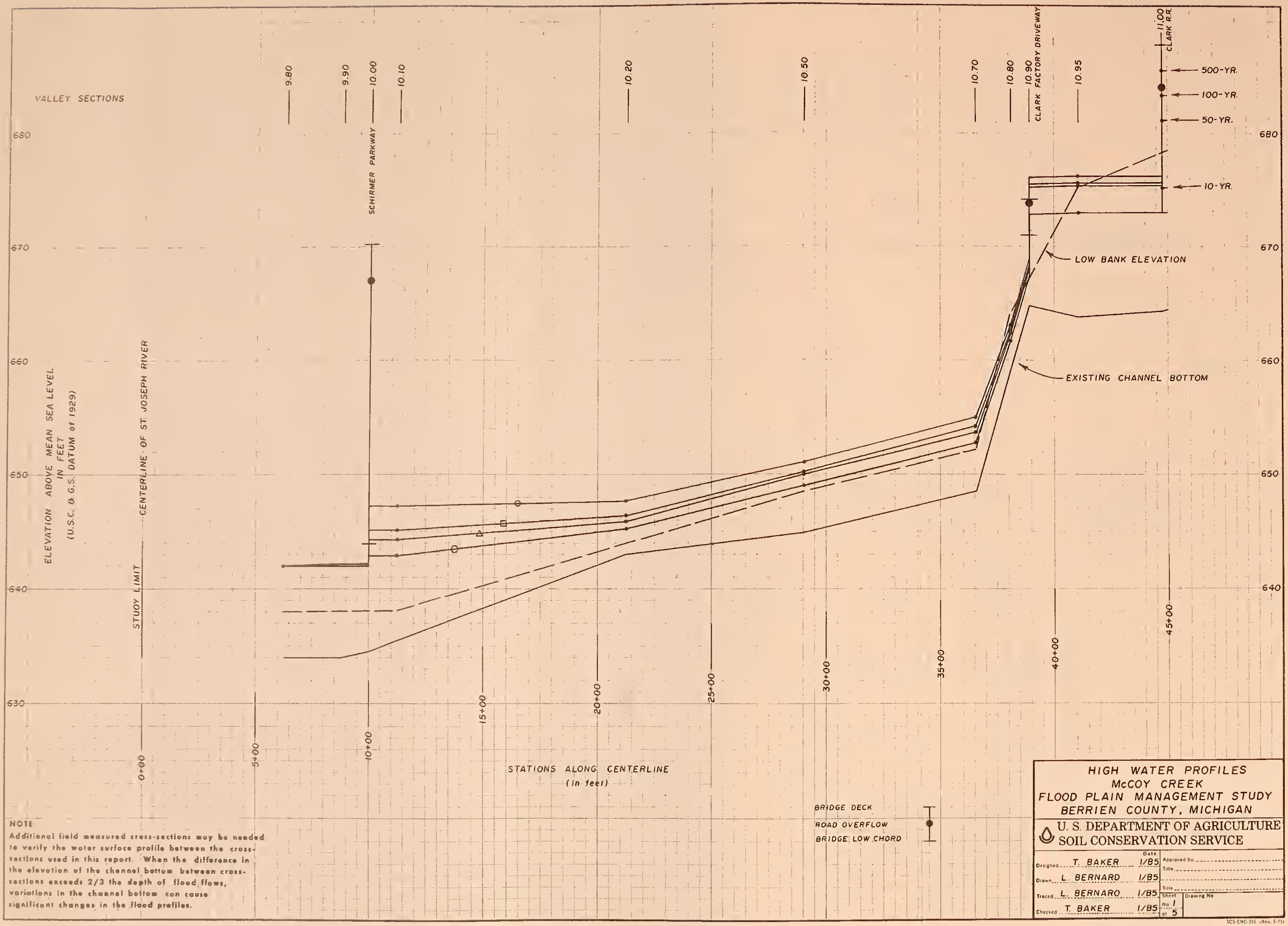


FIGURE 2
PHOTO SHEET INDEX MAP
McCoy Creek
FLOOD PLAIN MANAGEMENT STUDY
BERRIEN COUNTY
MICHIGAN

SOURCE:
MAP FURNISHED BY SCS
FIELD PERSONNEL

SEPTEMBER 1985 4-R-39417-2

USDA SCS NATIONAL CARTOGRAPHIC CENTER FT WORTH TX 1985



NOTE:
Additional field measured cross-sections may be needed to verify the water surface profile between the cross-sections used in this report. When the difference in the elevation of the channel bottom between cross-sections exceeds 2/3 the depth of flood flows, variations in the channel bottom can cause significant changes in the flood profiles.

HIGH WATER PROFILES
McCOY CREEK
FLOOD PLAIN MANAGEMENT STUDY
BERRIEN COUNTY, MICHIGAN

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	
Designed	T. BAKER	1/85	Approved by
Drawn	L. BERNARD	1/85	Title
Traced	L. BERNARD	1/85	Title
Checked	T. BAKER	1/85	Sheet No. 1 of 5 / Drawing No.

SCS-ENG-316 (Rev. 6-75)

USDA-SCS NATIONAL CARTOGRAPHIC CENTER FT WORTH TX 1986

LEGEND

100 Year Flood Hazard Area

500 Year Flood Hazard Area

20.30 Valley Section Location

Stream Channel

0+00 Channel Station

NOTE:
LIMITS OF FLOODING SHOWN MAY VARY FROM ACTUAL LOCATIONS ON THE GROUND AND DUE TO INHERENT AERIAL PHOTOGRAPHIC DISPLACEMENT THE PHOTOGRAPHIC IMAGE MAY VARY FROM TRUE GROUND LOCATION.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

1984 Photography From
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SEPTEMBER 1985 4-R-39417

SHEET 1 OF 5

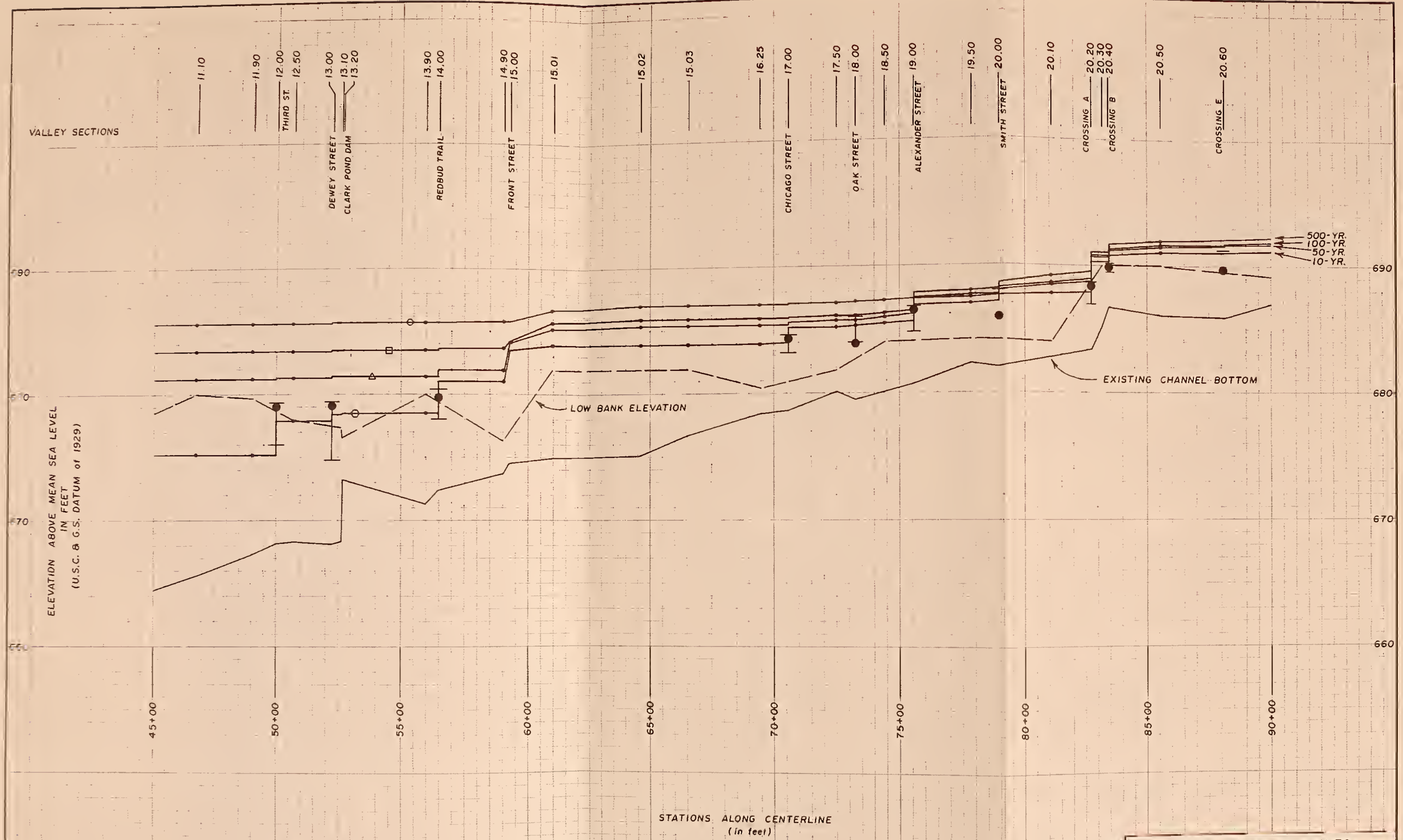
Figure 2

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

McCOY CREEK
FLOOD PLAIN MANAGEMENT STUDY
BERRIEN COUNTY, MICHIGAN

FLOOD HAZARD AREA

McCOY CREEK



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HIGH WATER PROFILES
FLOOD PLAIN MANAGEMENT STUDY
McCOY CREEK
BERRIEN COUNTY, MICHIGAN

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	
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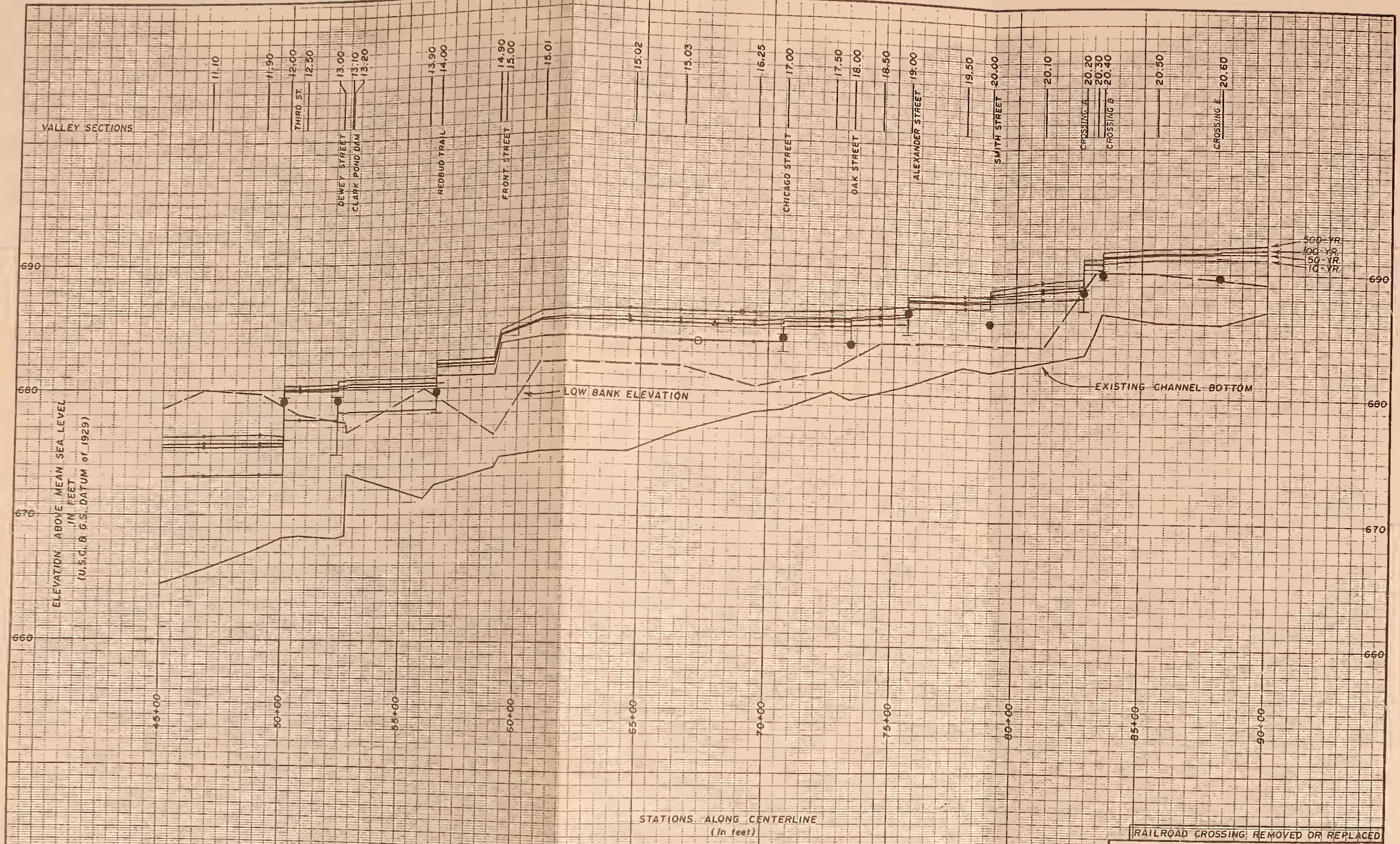
Checked	T. BAKER	1/85	Drawing No.

SCS ENG-316 (Rev. 6-75)



NOTE:
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BRIDGE DECK
ROAD OVERFLOW
BRIDGE LOW CHORD

RAILROAD CROSSING REMOVED OR REPLACED

HIGH WATER PROFILES
FLOOD PLAIN MANAGEMENT STUDY
McCOY CREEK
BERRIEN COUNTY, MICHIGAN

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

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SCS-ENG-316 (Rev. 6-75)

LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- 20.30 Valley Section Location
- Stream Channel
- 0+00 Channel Station

NOTE
LIMITS OF FLOODING SHOWN MAY VARY FROM ACTUAL LOCATIONS ON THE GROUND AND DUE TO INHERENT AERIAL PHOTOGRAPHIC DISPLACEMENT THE PHOTOGRAPHIC IMAGE MAY VARY FROM TRUE GROUND LOCATION.

SCALE 0 — 400 — 800 FEET
0 — 100 — 200 METERS
APPROXIMATE

1984 Photography From Abrams Aerial Survey Corp.

SHEET 2 OF 5

Figure 4

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

McCOY CREEK
FLOOD PLAIN MANAGEMENT STUDY
BERRIEN COUNTY, MICHIGAN
Railroad Crossing Removed or Replaced

FLOOD HAZARD AREA

McCOY CREEK

SEPTEMBER 1985 4-R-39417
USDA-SCS NATIONAL CARTOGRAPHIC CENTER FT WORTH TX 1985

LEGEND

100 Year Flood Hazard Area

500 Year Flood Hazard Area

20.30 Valley Section Location

Stream Channel

0+00 Channel Station

NOTE:
LIMITS OF FLOODING SHOWN MAY VARY FROM ACTUAL LOCATIONS ON THE GROUND AND DUE TO INHERENT AERIAL PHOTOGRAPHIC DISPLACEMENT THE PHOTOGRAPHIC IMAGE MAY VARY FROM TRUE GROUND LOCATION

SCALE 0 — 400 — 800 FEET
0 — 100 — 200 METERS
APPROXIMATE

1984 Photography From Abrams Aerial Survey Corp.

SEPTEMBER 1985 4-R-39417

SHEET 2 OF 5

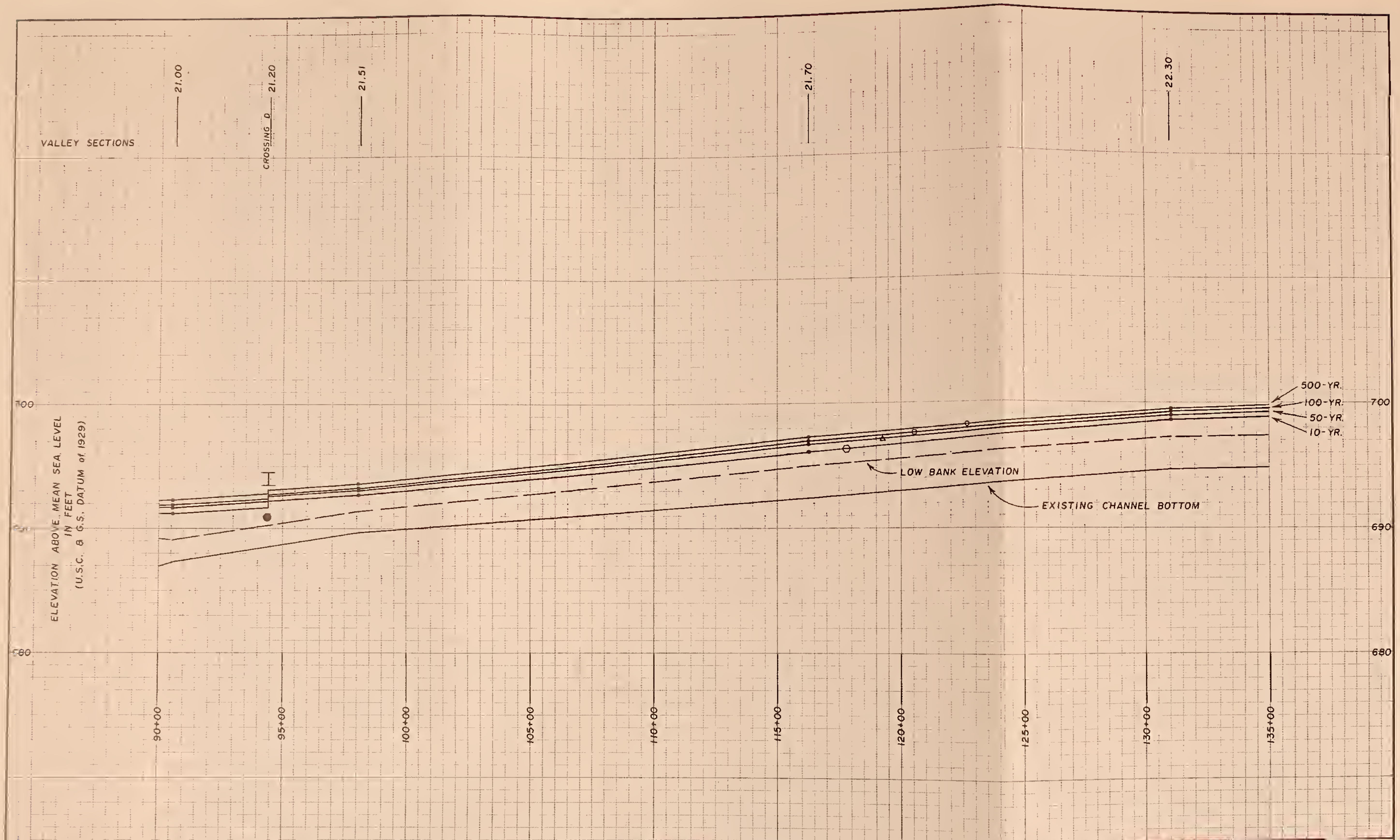
Figure 2

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

McCOY CREEK
FLOOD PLAIN MANAGEMENT STUDY
BERRIEN COUNTY, MICHIGAN

FLOOD HAZARD AREA

McCOY CREEK



NOTE:
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HIGH WATER PROFILES
McCOY CREEK
FLOOD PLAIN MANAGEMENT STUDY
BERRIEN COUNTY, MICHIGAN

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	
Designed	T. BAKER	1/85	Approved by
Drawn	L. BERNARD	1/85	Title
Traced	L. BERNARD	1/85	Sheet No. 3 of 5
Checked	T. BAKER	1/85	Drawing No.

SCS-ENG-316 (Rev. 6-75)

LEGEND

(light blue)	100 Year Flood Hazard Area	(stream symbol)	Stream Channel
(dark blue)	500 Year Flood Hazard Area	0+00	Channel Station
20.30	Valley Section Location		

NOTE:
LIMITS OF FLOOOING SHOWN MAY VARY FROM ACTUAL LOCATIONS ON THE GROUND AND DUE TO INHERENT AERIAL PHOTOGRAPHIC DISPLACEMENT THE PHOTOGRAPHIC IMAGE MAY VARY FROM TRUE GROUND LOCATION.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

1984 Photography From
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SEPTEMBER 1995 4-R-39417

SHEET 3 OF 5

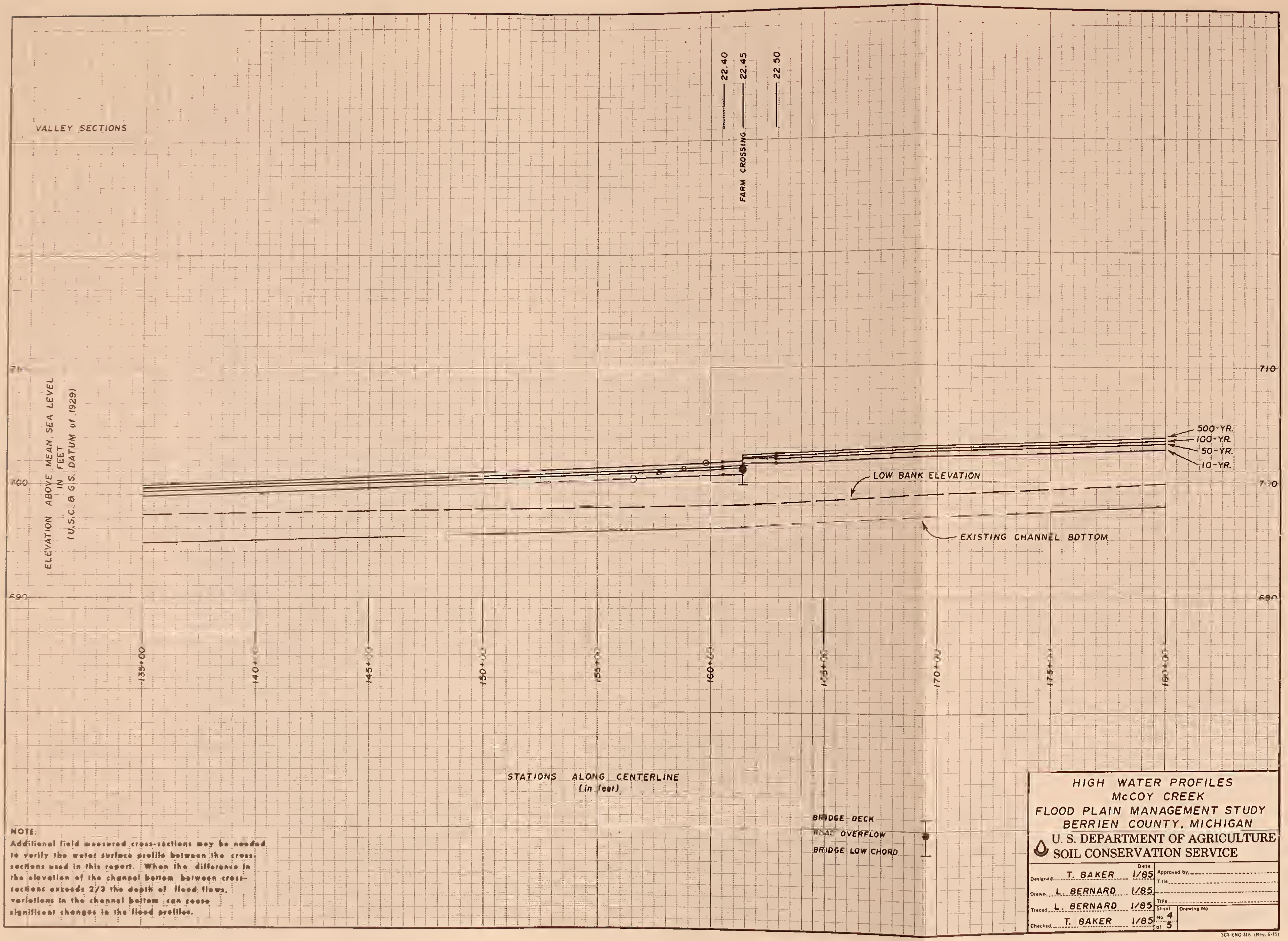
Figure 2

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

McCOY CREEK
FLOOD PLAIN MANAGEMENT STUDY
BERRIEN COUNTY, MICHIGAN

FLOOD HAZARD AREA

McCOY CREEK


VALLEY SECTIONS
22.40
22.45
22.50
FARM CROSSING
710
700
690
ELEVATION ABOVE MEAN SEA LEVEL IN FEET
(U.S.C. & G.S. DATUM of 1929)
500-YR.
100-YR.
50-YR.
10-YR.
LOW BANK ELEVATION
EXISTING CHANNEL BOTTOM
135+00
140+00
145+00
150+00
155+00
160+00
165+00
170+00
175+00
180+00
STATIONS ALONG CENTERLINE
(in feet)
BRIDGE DECK
ROAD OVERFLOW
BRIDGE LOW CHORD
NOTE:
Additional field measured cross-sections may be needed to verify the water surface profile between the cross-sections used in this report. When the difference in the elevation of the channel bottom between cross-sections exceeds 2/3 the depth of flood flows, variations in the channel bottom can cause significant changes in the flood profiles.
HIGH WATER PROFILES
McCOY CREEK
FLOOD PLAIN MANAGEMENT STUDY
BERRIEN COUNTY, MICHIGAN
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Designed T. BAKER Date 1/85
Drawn L. BERNARD 1/85
Traced L. BERNARD 1/85
Checked T. BAKER 1/85
Approved by
Title
Title
Sheet No. 4 of 5
Drawing No
SCS-ENG-316 (Rev. 6-75)

USDA SCS NATIONAL CARTOGRAPHIC CENTER FT WORTH TX 1986

LEGEND

(light blue)	100 Year Flood Hazard Area	(stream symbol)	Stream Channel
(blue)	500 Year Flood Hazard Area	0+00	Channel Station
20.30	Valley Section Location		

NOTE:
LIMITS OF FLOODING SHOWN MAY VARY FROM ACTUAL LOCATIONS ON THE GROUND AND DUE TO INHERENT AERIAL PHOTOGRAPHIC DISPLACEMENT THE PHOTOGRAPHIC IMAGE MAY VARY FROM TRUE GROUND LOCATION.

SCALE 0 — 400 — 800 FEET
0 — 100 — 200 METERS
APPROXIMATE

1984 Photography From Abrams Aerial Survey Corp.

SEPTEMBER 1985 4-R-39417

SHEET 4 OF 5

Figure 2

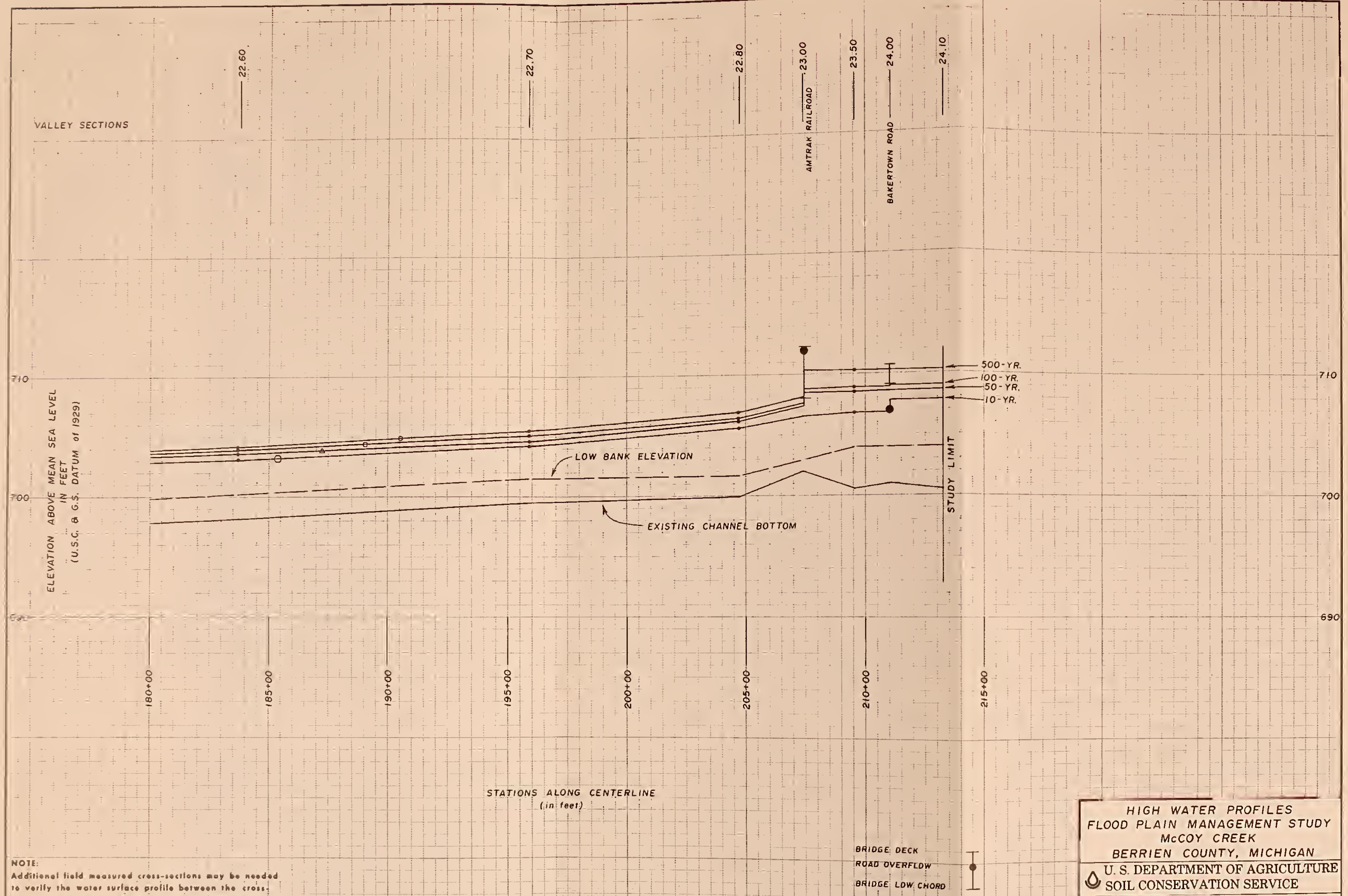
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

McCOY CREEK FLOOD PLAIN MANAGEMENT STUDY

BERRIEN COUNTY, MICHIGAN

FLOOD HAZARD AREA

McCOY CREEK



NOTE:
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HIGH WATER PROFILES
FLOOD PLAIN MANAGEMENT STUDY
McCOY CREEK
BERRIEN COUNTY, MICHIGAN

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	
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Drawn	L. BERNARO	1/85	Title
Traced	L. BERNARO	1/85	Sheet No. 5 of 5
Checked	T. BAKER	1/85	Drawing No.

SCS-ENG-316 (Rev. 6-71)

LEGEND

- 100 Year Flood Hazard Area
- 500 Year Flood Hazard Area
- 20.30 Valley Section Location
- Stream Channel
- 0+00 Channel Station

NOTE:
LIMITS OF FLOODING SHOWN MAY VARY FROM ACTUAL LOCATIONS ON THE GROUND AND DUE TO INHERENT AERIAL PHOTOGRAPHIC DISPLACEMENT THE PHOTOGRAPHIC IMAGE MAY VARY FROM TRUE GROUND LOCATION.

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

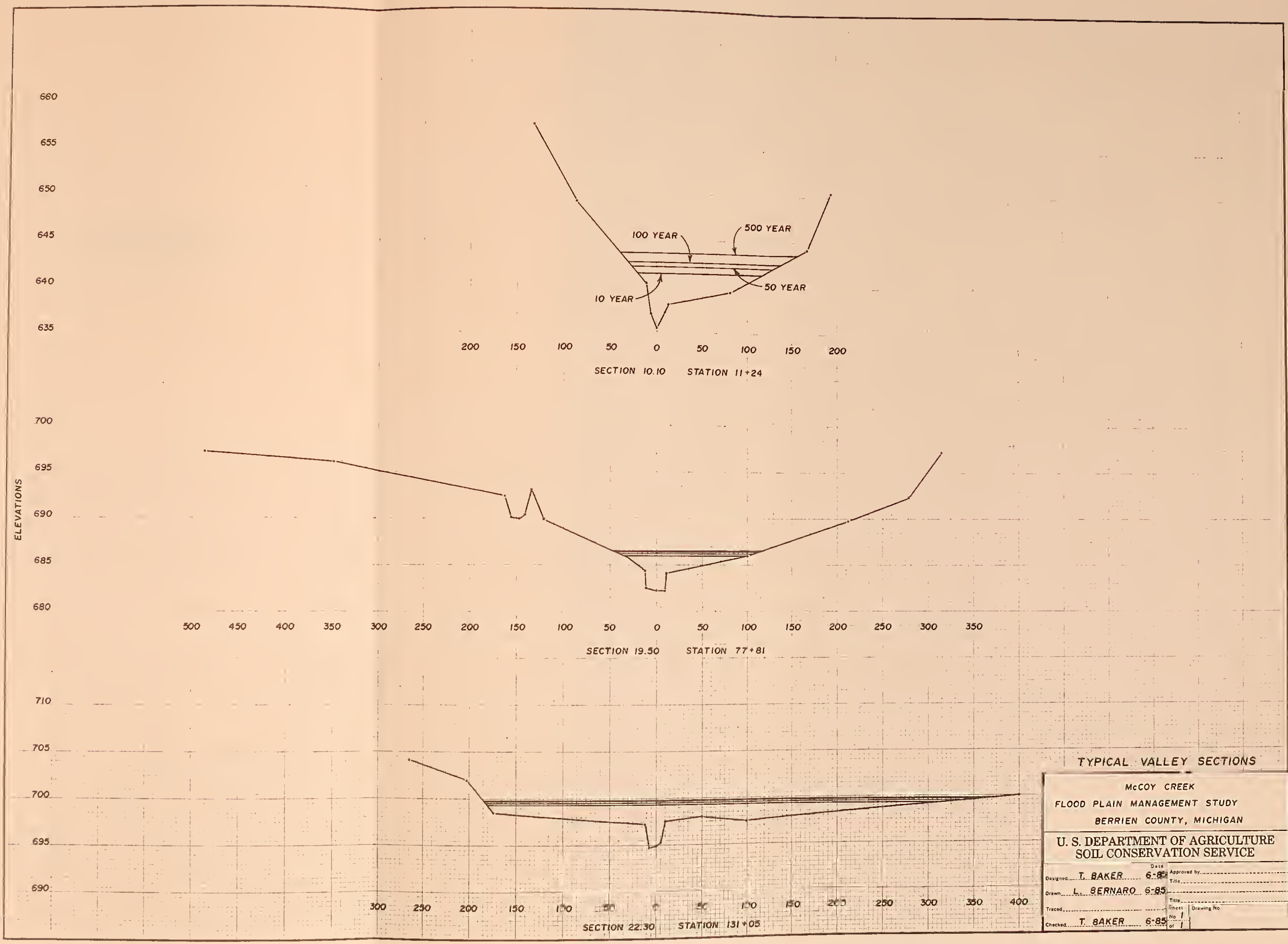
1984 Photography From
Abrams Aerial Survey Corp.

SHEET 5 OF 5	Figure 2	U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE **McCOY CREEK FLOOD PLAIN MANAGEMENT STUDY** BERRIEN COUNTY, MICHIGAN	**FLOOD HAZARD AREA** **McCOY CREEK**

SEPTEMBER 1985 4-R-39417

USDA SCS NATIONAL CARTOGRAPHIC CENTER FT WORTH TX 1985

APPENDIX B



ELEVATIONS
660
655
650
645
640
635
100 YEAR
500 YEAR
10 YEAR
50 YEAR
200 150 100 50 0 50 100 150 200
SECTION 10.10 STATION 11+24
700
695
690
685
680
500 450 400 350 300 250 200 150 100 50 0 50 100 150 200 250 300 350
SECTION 19.50 STATION 77+81
710
705
700
695
690
300 250 200 150 100 50 0 50 100 150 200 250 300 350 400
SECTION 22.30 STATION 131+05
TYPICAL VALLEY SECTIONS
McCOY CREEK
FLOOD PLAIN MANAGEMENT STUDY
BERRIEN COUNTY, MICHIGAN
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Designed T. BAKER 6-85
Drawn L. BERNARO 6-85
Traced
Checked T. BAKER 6-85
Approved by
Title
Date
Sheet No. 1 of 1
Drawing No.

APPENDIX C

TABLE 2 - FLOOD DISCHARGES

McCOY CREEK

Location	TR-20 Sec.	From Sec.	To Sec.	Drainage Area	Estimated Peak Discharges			
					10 Yr.	50 Yr.	100 Yr.	500 Yr.
				Sq. Miles	-cubic feet per second-			
From Bakertown Road to Amtrak Crossing	21	24.00	23.00	10.82	325	535	620	855
To McCoy-Mill Race Junction	26	22.80	21.70	11.67	350	570	665	915
To Upstream of Schirmer Parkway	31	21.51	10.50	13.45	410	670	780	1,065
To St. Joseph River	39	10.20	9.80	18.25	505	825	950	1,290

TABLE 3A - FLOOD ELEVATIONS AT SECTIONS

WITHOUT CLARK RAILROAD FILL

McCOY CREEK

Location	Section	Station	10-Year	50-Year	100-Year	500-Year
Confluence	9.80	6+26	642.0	642.0	642.0	642.0
St. Joseph River	9.90	8+76	642.0	642.1	642.1	642.2
Schirmer	10.00 D 1/	8+86	642.0	642.1	642.1	642.2
Parkway	10.00 U 1/	11+14	642.9	644.3	645.1	647.2
	10.10	11+24	642.9	644.3	645.1	647.2
	10.20	21+30	645.3	645.9	646.4	647.7
	10.50	29+04	649.0	650.0	650.2	651.0
	10.70	36+54	652.8	653.7	654.2	655.0
	10.80	38+10	661.7	662.4	662.6	663.1
Crossing	10.90 D	38+60	667.4	668.0	668.3	668.8
Upstream of Clark Falls	10.90 U	39+14	672.9	675.3	675.5	676.0
	10.95	41+14	673.0	675.3	675.6	676.1
	11.10	46+70	673.1	675.4	675.7	676.2
	11.90	49+05	673.2	675.5	675.7	676.3
3rd Street	12.00 D	49+65	673.2	675.5	675.7	676.3
Crossing	12.00 U	50+29	677.6	679.9	680.0	680.4
	12.50	50+69	677.6	679.9	680.0	680.4
Dewey Street	13.00 D	51+34	677.6	679.9	680.1	680.4
Crossing	13.00 U	52+54	678.2	680.1	680.3	680.7
	13.10	52+60	678.2	680.1	680.3	680.7
Clark Pond Weir	13.20	52+70	678.2	680.2	680.4	680.8
	13.90	55+96	678.3	680.2	680.4	680.8
Red Bud Trail	14.00 D	56+45	678.3	680.2	680.4	680.8
Crossing	14.00 U	57+95	681.0	681.7	681.9	682.2
	14.90	59+00	681.0	681.8	682.0	682.4
	15.00	59+26	683.5	684.1	684.2	684.6
	15.01	60+96	683.9	685.1	685.3	685.9
	15.02	64+66	683.9	685.3	685.6	686.2
	15.03	66+60	683.9	685.3	685.6	686.3
	16.25	69+46	683.9	685.3	685.6	686.3

1/ D and U represent downstream and upstream faces of bridge and indicates bridge head losses for the tabulated floods.

TABLE 3A - FLOOD ELEVATIONS AT SECTIONS - CONTINUED

WITHOUT CLARK RAILROAD FILL

McCOY CREEK

Location	Section	Station	10-Year	50-Year	100-Year	500-Year
Chicago Street	17.00 D	70+26	684.0	685.4	685.7	686.4
Crossing	17.00 U	70+96	685.2	685.6	685.8	686.4
	17.50	72+51	685.2	685.7	685.9	686.5
Oak Street	18.00 D	72+98	685.3	685.7	686.0	686.6
Crossing	18.00 U	73+54	685.4	685.8	686.1	686.6
	18.50	74+41	685.5	686.0	686.2	686.8
Alexander	19.00 D	75+29	685.6	686.2	686.4	687.0
Street Crossing	19.00 U	75+84	686.9	687.4	687.5	687.8
	19.50	77+81	687.0	687.5	687.6	688.0
Smith Street	20.00 D	78+61	687.0	687.6	687.7	688.1
Crossing	20.00 U	79+21	687.6	688.1	688.3	688.6
	20.10	81+16	687.8	688.5	688.7	689.2
Crossing "A"	20.20 D	82+36	687.9	688.7	688.9	689.5
Forged Products	20.20 U	83+06	690.3	690.7	690.8	691.1
	20.30	83+21	690.3	690.7	690.8	691.1
Crossing "B"	20.40 D	83+36	690.3	690.7	690.8	691.1
Forged Products	20.40 U	83+51	690.8	691.2	691.3	691.7
	20.50	85+57	691.1	691.5	691.6	692.0
Crossing "E"	20.60 D	87+97	691.1	691.6	691.7	692.1
Forged Products	20.60 U	88+15	691.1	691.7	691.8	692.1
	21.00	90+55	691.2	691.7	691.9	692.3
Crossing "D"	21.20 D	94+25	691.7	692.2	692.4	692.8
Forged Products	21.20 U	94+50	692.2	692.6	692.7	693.1

TABLE 3A - FLOOD ELEVATIONS AT SECTIONS - CONTINUED

WITHOUT CLARK RAILROAD FILL

McCOY CREEK

Location	Section	Station	10-Year	50-Year	100-Year	500-Year
Junction McCoy Creek and Mill Race	21.51	98+10	692.7	693.1	693.2	693.6
	21.70	116+25	696.1	696.7	697.0	697.3
	22.30	131+05	698.6	699.0	699.3	699.5
	22.40	160+55	700.7	701.2	701.5	701.8
Farm Crossing	22.45 D	161+30	700.7	701.2	701.5	701.9
	22.45 U	161+40	701.7	702.1	702.2	702.4
	22.50	162+85	701.7	702.2	702.3	702.5
	22.60	183+70	703.1	703.7	703.9	704.2
	22.70	195+80	704.2	704.9	705.1	705.5
	22.80	204+70	705.6	706.2	706.4	706.9
Amtrak Crossing	23.00 D	207+25	706.5	707.4	707.6	708.1
	23.00 U	207+55	706.5	708.5	708.8	710.3
	23.50	209+55	706.8	708.5	708.9	710.3
Bakertown Road Crossing	24.00 D	210+90	706.8	708.6	708.9	710.3
	24.00 U	211+26	707.8	708.6	709.0	710.3
	24.10	213+25	707.8	708.6	709.0	710.3

1868C

APPENDIX D

INVESTIGATIONS AND ANALYSES

SURVEY PROCEDURES

Field surveys were made of bridges, roads, structures and the channel and flood plain within the study area by the Soil Conservation Service in 1984. Temporary bench marks based on USC&GS mean sea level elevations datum of 1929 were also set at this time and used for this study. Surveys were made using third order accuracy.

For McCoy Creek, 20 valley and channel cross-sections plus 17 roads, bridges and structures were surveyed. Aerial photography flown April 1, 1984 was used as a base for the photo mosaic sheets used to delineate the flood plain and to develop 2-foot contour maps. The 2-foot contour maps were then used to develop 16 additional valley cross-sections.

HYDROLOGY AND HYDRAULICS

Physical data were obtained from USGS topographic maps, soil survey maps, local topographic maps and aerial photographs, as well as on-site field inspections. The watershed boundary was determined from map studies and field checks. The watershed was divided into 15 sub-watershed areas for use in evaluating the hydrologic volumes and times. Drainage areas for the sub-watersheds were measured from USGS quadrangle maps. Times of concentration were calculated for each of the sub-watersheds using the Upland Flow method. Each sub-watershed was evaluated for land use, soil group, runoff curve number and time concentration.

Channel flood routings to establish peak discharge-frequency relationships were made using the SCS TR-20 Hydrology Computer Program dated September 1, 1983, with U.S. Department of Agriculture computer facilities. The Modified Attenuation-Kinematic (Att-Kin) method of routing through stream channels is used by this program. This method is derived from inflow-outflow hydrograph relationships. Several types of data were used in developing this watershed model. Time of concentration for each local drainage area was computed from sub-watershed relief, hydraulics and travel length. Drainage area, hydrologic soil groups and land use and cover were used to develop runoff hydrographs.

Temporary flood water storage at several road culverts and bridges was recognized as a potential to modify downstream peak discharges. Data were gathered and evaluated. Opening sizes and type, head available from the top of opening to top of road fill and storage shapes were determined.

Two structures and four valley sections were selected and evaluated to effectively model study area conditions. Elevation-storage-discharge relationships were determined for the two structure sections and elevation-discharge-area relationships were determined for the four valley sections. The TR-20 computer program uses this data and the Storage-Indication method of evaluating the effect of the structures in reducing peak flood discharges. The lakes associated with the structures play an important role in reducing the peak discharges. Table 2 (Appendix C) lists discharges obtained from the flood routings.

The computer model was verified using historic rainfall and flood information. Flood photographs of a 4.7 inch rainfall in 6 hours showed similar elevations to the 100-year flood. The 6 hour, 100-year flood is approximately 4.7 inches. A comparison of 100-year McCoy Creek TR-20 flows with Galena River (04096100) as discussed on pages 68 and 97 of "Techniques for Estimating Magnitude and Frequency of Floods on Streams in Indiana" shows the CSM rates are within 3 percent. This comparison is in Appendix 14 of the technical support documentation.

Water surface profiles were developed using the Soil Conservation Service computer program WSP2. This program uses the Step method of computation to solve the Bernoulli equation, the Bureau of Public Roads bridge loss procedures and the culvert loss analysis. Flood discharges determined from flood routings were used in the water surface profile program to develop high water profiles. Manning's "n" values were determined from field investigations of the channel and flood plains.

Normal bridge and channel flow conditions were assumed in the hydraulic computations. No consideration was made for openings blocked by ice or other debris. Channel and flood plain flow characteristics may change due to vegetative growth, sedimentation, scour, debris accumulation, filling and encroachment. Computations for this study considered only those features in the flood plain at the time of field surveys, with the exception of the railroad fill discussed at the end of this section. Future flood plain developments and modifications, as well as changes in the upstream drainage area land use and cover, will require recomputation of the water surface profiles.

Approximately 1,900 feet upstream from Smith Street, a portion of McCoy Creek's flow is diverted into a small mill race. This mill race flows for a distance of approximately 2,800 feet before it passes over a 20 foot overfall. From here, the mill race flows for approximately 200 feet, where it rejoins McCoy Creek at section 15.02. Initial stage-discharge computations for the mill race revealed that just downstream from the diversion point, bankfull flow was only 24 cfs.

Because of the mill race's location, upslope and parallel to McCoy Creek, any flows above this 24 cfs would overtop its banks and flow overland a short distance back into McCoy Creek. In using WSP2 to compute final water surface profiles, it was decided to ignore any flow in the mill race and assume that all flow proceeds down McCoy Creek, since the mill race portion is a small percentage of the total.

Flood plain delineations were made on the contour maps and photomap sheets. Computed water surface elevations at surveyed sections and bridges were used to identify flood plain limits. Between sections, topographic map interpretations and field inspections were used to delineate the flood boundary lines. Limits of flooding shown on the photomaps may vary from actual location on the ground and the photographic image may vary from true ground location due to inherent aerial photographic displacement. High water profile elevations and detailed field surveys should be used to determine the extent or depth of flooding at any specific site.

Where the limits of the 500-year and the 100-year floods were too close to delineate, the limits of the two flood plains are shown as the same line on the photomap sheets.

At section 15.03, McCoy Creek enters into a concrete rectangular channel at Roe Street and flows underneath the west side of Days Avenue. The sidewalk on this side of the street acts as a cover for this 7 by 10 foot channel. Approximately 500 feet downstream from this entrance, the channel changes abruptly from a rectangular cross-section into a 6 by 13 foot masonry arch, angles northeast and continues for 200 feet, where it outlets as an open channel north of Front Street at section 14.90.

Instead of using WSP2 directly to calculate water surface profiles in this reach, a combination of hand and computer calculations were used. (WSP2 cannot handle backwater computations for two differently sized and shaped culverts in series. Also, it was decided that flow above the culverts down the street would not represent a weir flow situation as WSP2 would assume.) The procedure used was as follows:

1. Given tailwater, assume a headwater elevation on the two pipes in series.

2. Calculate a flow using an equation describing the hydraulic characteristics of the two pipes.

3. Flow from 2, above, is subtracted from the total flow (as determined by TR-20 for this reach) and WSP2 is used to calculate a water surface profile (assuming only overland flow) up to the entrance, or headwater, of the two pipes.

4. Compare the assumed headwater elevation from 1, above, with the elevation calculated from overland flow 3, above.

5. Adjust assumed headwater elevation up or down and repeat 2, above, through 4, above, until assumed and calculated headwaters match.

The railroad fill in the Clark Equipment Complex will soon be removed, so the alternative of removing it is included here. Table 3A (Appendix C) shows the flood elevations that will apply when that fill is removed.

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APPENDIX E

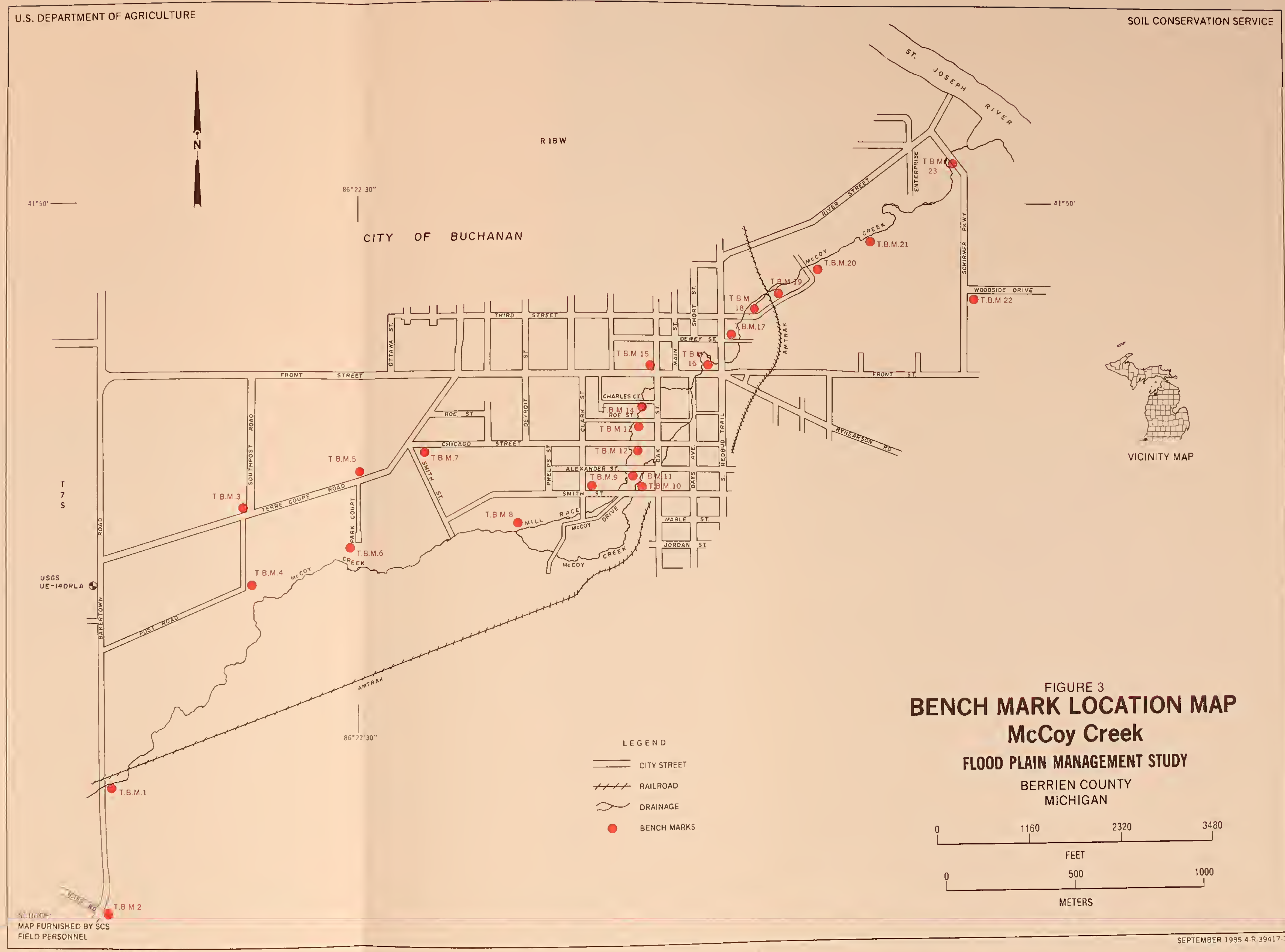

FIGURE 3
BENCH MARK LOCATION MAP
McCoy Creek
FLOOD PLAIN MANAGEMENT STUDY
BERRIEN COUNTY
MICHIGAN

BENCH MARK DESCRIPTIONS *

McCOY CREEK

BERRIEN COUNTY, MICHIGAN

UE-14DRLA

Section 34, T8S, R18W - On concrete box culvert, approximately 450 feet south of Terre Coupe Road along Bakertown Road.

Chiseled square in center of the north headwall, 21 feet west of centerline of Bakertown Road.

Elev. 733.55

TBM #1

Section 34, T8S, R18W - At McCoy Creek crossing along Bakertown Road.

Chiseled "x" painted on top of northeast headwall, 24 feet east of centerline of Bakertown Road.

Elev. 711.11

TBM #2

Section 3, T8S, R18W - East of intersection of Bakertown and Hass Roads at 1565 Bakertown Road.

SCS disk and nail in power pole #B62119.

Elev. 723.73

TBM #3

Section 34, T8S, R18W - Northwest of intersection of Terre Coupe Road and Post Road.

SCS disk and nail in side of power pole #B59433.

Elev. 722.07

* Elevations based on USC&GS mean sea level datum of 1929.

TBM #4

Section 34, T8S, R18W - At bend in Post Road in southeast corner of new Industrial Park.

SCS disk and nail in power pole #B594208 east of Post Road.

Elev. 708.50

TBM #5

Section 35, T8S, R18W - North of intersection of Terre Coupe Road and Park Court (Hill Street).

SCS disk and nail in power pole #B595230.

Elev. 730.50

TBM #6

Section 35, T8S, R18W - Southeast corner post of firewood shed west of Jack Smallwood house at south end of Park Court.

SCS disk and nail in southeast corner post.

Elev. 700.70

TBM #7

Section 35, T8S, R18W - Southeast of intersection of Chicago Street and Smith Street.

SCS disk and nail in power pole #B595479.

Elev. 704.78

TBM #8

Section 35, T8S, R18W - 80 feet north of upstream junction of McCoy Creek and Mill Race.

SCS disk and nail in cottonwood tree 6 inches above ground.

Elev. 693.02

TBM #9

Section 35, T8S, R18W - Northeast of intersection of Clark Street and Smith Street.

SCS disk and nail in power pole #B595146.

Elev. 701.02

TBM #10

Section 35, T8S, R18W - East of McCoy Creek and north of Smith Street.

SCS disk and nail in power pole #B595143.

Elev. 693.94

TBM #11

Section 35, T8S, R18W - South of Alexander Street and east of Mill Race.

SCS disk and nail in power pole #B595435.

Elev. 693.55

TBM #12

Section 35, T8S, R18W - At Mill Race crossing on Chicago Street west of Buchanan General Baptist Church.

Chiseled and yellow painted square on southeast corner of wingwall.

Elev. 692.69

TBM #13

Section 35, T8S, R18W - At Mill Race crossing on Roe Street and east of stream.

Chiseled and painted square on top of southeast wingwall.

Elev. 693.99

TBM #14

Section 35, T8S, R18W - West of Mill Race and south of Charles Court in front of 106 Charles Court.

SCS disk and nail in power pole #B59599.

Elev. 694.70

TBM #15

Section 26, T8S, R18W - Northeast of intersection of Front Street and Oak Street.

On the letter "T" spelling "TRAVERSE" on top of fire hydrant.

Elev. 693.35

TBM #16

Section 26, T8S, R18W - At stream west of Rexall Drug Store at 257 East Front Street.

SCS nail and disk on west side of 4th vertical post north of stair walkway.

Elev. 678.31

TBM #17

Section 25, T8S, R18W - Northeast of intersection of Dewey Street and Red Bud Trail.

SCS disk and nail in power pole #3570-28.

Elev. 680.87

TBM #18

Section 25, T8S, R18W - 75 feet northwest of the northwest corner of the Tech Nickel, Inc. factory and on the east side of the creek.

SCS disk and nail in power pole.

Elev. 681.06

TBM #19

Section 25, T8S, R18W - In old Clark Equipment Complex east of railroad and south of creek.

SCS disk and nail in power pole.

Elev. 686.91

TBM #20

Section 25, T8S, R18W - In old Clark Equipment Complex and southwest from rapids in creek.

SCS disk and nail in power pole.

Elev. 678.36

TBM #21

Section 25, T8S, R18W - South of the creek, opposite the sewage treatment plant and 200 feet northwest of the northwest corner of the eastern most building in the old Clark Equipment Complex.

SCS disk and nail in power pole #357080.

Elev. 683.58

TBM #22

Section 25, T8S, R18W - Southeast of intersection of Woodside Drive and Schirmer Parkway.

SCS disk and nail in power pole #B570657.

Elev. 689.90

TBM #23

Section 25, T8S, R18W - In front of power station west of Schirmer Parkway and south of the creek.

SCS disk and nail in top of rail post.

Elev. 668.78

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APPENDIX F

GLOSSARY

BACKWATER--The resulting highwater surface upstream from a dam, bridge or other obstruction in a river channel or high stages in a receiving stream.

BRIDGE DECK--Elevation of road surface at the bridge.

BRIDGE LOW CLEARANCE--The lowest point of a bridge or other structure over or across a river, stream or water course that limits the opening through which water flows. This is referred to as "low steel" or "low chord". It often is higher than the low point of the roadway.

CHANNEL OR WATER COURSE--An elongated depression either natural or man-made having a bed and well-defined banks varying in depth, width and length which gives direction to a current of water and is normally described as a creek, stream or riverbed.

CHANNEL BOTTOM--The lowest part of the stream channel (either in a constructed cross-section or a natural channel). Bottom elevations at a series of points along the length of a stream may be plotted and connected to provide a stream bottom profile.

CONFLUENCE--A flowing together or place of junction of two or more streams.

CROSS-SECTION OR VALLEY SECTION--A graph showing the shape of the stream bed, banks and adjacent land on either side made by plotting elevations at measured distances along a line perpendicular to the flow of the stream.

DATUM--An assumed reference plane from which elevations and depths are measured such as from sea level.

HIGH WATER OR FLOOD PROFILE--A graph showing the relationship of water surface elevation location along the stream. While it is drawn to show surface elevations for the crest of a specific flood, it may be prepared for conditions at any other given time or stage.

ELEVATION-DISCHARGE RELATIONSHIP--The relationship between water surface elevation and rate of flow at a specified location for a range of flow rates.

FLOOD--A temporary overflow by a river, stream, ocean, lake or other body of lands not normally covered by water. It does not include the ponding of surface water due to inadequate drainage such as within a development. It is characterized by damaging inundation, backwater effects of surcharging sewers and local drainage channels, and by unsanitary conditions within adjoining flooded habitated area attributable to pollutants, debris and water table.

FLOOD CREST--The maximum stage or elevation reached by flood waters at a given location.

FLOOD FREQUENCY--A means of expressing the probability of flood occurrences as determined from a statistical analysis of representative stream flow or rainfall and runoff records. It is customary to estimate the frequency with which specific flood stages or discharges may be equalled or exceeded, rather than the frequency of an exact stage or discharge. Such estimates by strict definition are designated "exceedence frequence", but in practice the term "frequency" is used. The frequency of a particular stage or discharge is usually expressed as occurring once in a specified number of years.

10-YEAR FLOOD--A flood having a long-term average frequency of occurrence in the order of once in 10 years. It has a 10 percent chance of being equalled or exceeded in any given year.

100-YEAR FLOOD--A flood having a long-term average frequency of occurrence in the order of once in 100 years. It has a one percent chance of being equalled or exceeded in any given year. This flood is comparable to the "Intermediate Regional Flood" used by the U.S. Army Corps of Engineers.

FLOOD PEAK--The maximum instantaneous discharge or volume of flow in cubic feet per second passing a given location. It usually occurs at or near the time of the flood crest.

FLOOD PLAIN--The relatively flat area or low lands covered by flood waters originating with either the adjoining channel of a water course such as a river or stream, or a body of standing water such as an ocean or lake.

FLOOD ROUTING--The process of determining progressively the timing and shape of a flood wave at successive points along a stream. This procedure is used to derive a downstream hydrograph from an upstream hydrograph. Local inflow and tributary hydrographs are considered.

FLOOD STAGE--The elevation at which overflow of the natural stream banks or body of water occurs.

FLOODWAY--The portion of the flood plain including the channel of the stream that is required for the conveyance of flood flow.

FLOODWAY FRINGE--The area of the flood plain lying outside the floodway which may be covered by flood waters originating from an adjoining river or stream.

HEAD LOSS--The effect of obstructions, such as narrow bridge openings, dams or buildings, that limit the area through which water must flow, raising the surface water upstream from the obstruction.

HEADWATER--The tributaries and upper reaches which are the sources of the stream.

HYDRAULICS--The science of the laws governing the motion of water and their practical applications.

HYDROGRAPH--A graph denoting the discharge or stage of flow over a period of time.

HYDROLOGY--The science dealing with the occurrence and movement of water upon and beneath the land areas of the earth.

INUNDATION--The flooding or overflow of an area with water.

LEFT BANK--The bank of the left side of a river, stream or water course, looking downstream.

LOW GROUND--The highest elevation at a specific stream channel cross-section at which the flow in the stream can be contained in the channel without overflowing into adjacent overbank areas.

MANNING'S "n"--A coefficient of channel and overbank roughness used in Manning's open channel flow formula, commonly called a retardance factor.

REACH LENGTH--A longitudinal length of stream channel selected for use in hydraulic or other computations.

RIGHT BANK--The bank on the right side of the river, stream or water course, looking downstream.

ROAD OVERFLOW--The lowest elevation on a road profile in the vicinity of where the road and stream cross. It is the first point on the roadway inundated if overtopping of the road occurs during a storm.

RUNOFF--That part of precipitation, as well as any other flow contributions, which appears in surface streams of either perennial or intermittent form.

TIME OF CONCENTRATION--Time required for water to flow from the most remote point of a watershed to the outlet or other point of reference.

WATERSHED--A drainage basin or area which collects runoff and transmits it, usually by means of streams and tributaries, to the outlet of the basin.

WATERSHED BOUNDARY--The divide separating one drainage basin from another.

APPENDIX G

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